

Comparison of Visual Sample Plan (VSP) Estimates to Final Site Data (Case Study)

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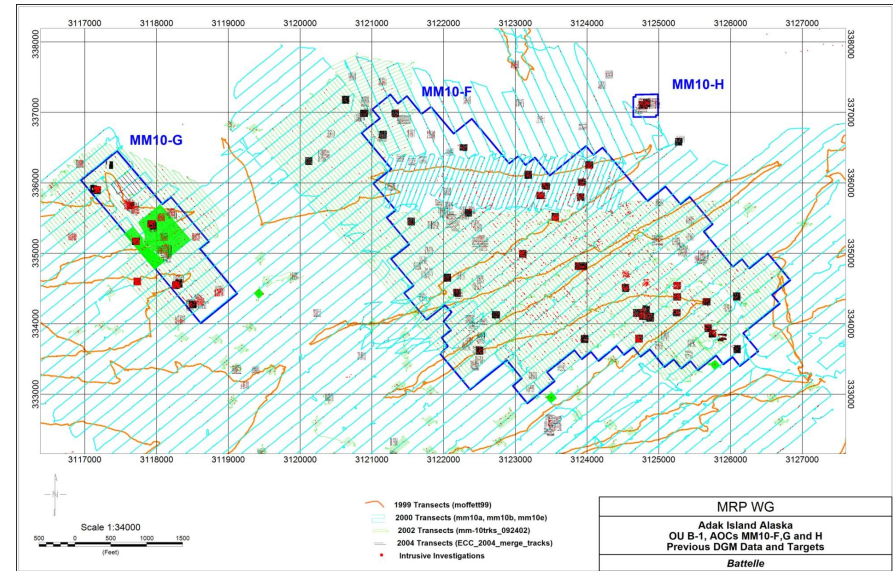
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Introduction

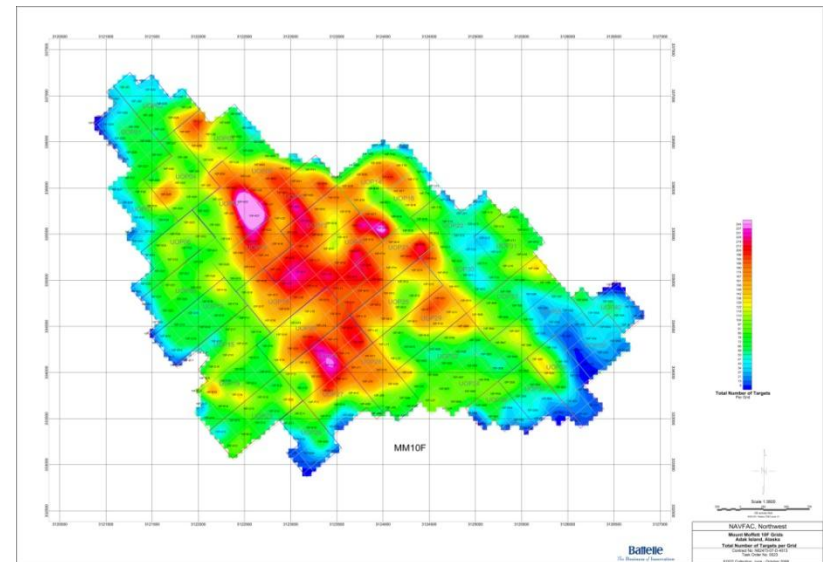
- What initiated the study?
 - In 2011, the MRP Workgroup was asked to support NAVFAC NW to respond to comments from the regulatory agencies on some calculations in a Feasibility Study – specifically, the anomaly count estimates used to develop the cost estimates
 - The FS used the method of estimating the number of target anomalies based on straight extrapolation from the RI data
 - How many anomalies/area during the RI
 - How much area in the RAA x anomalies/area equals estimate of targets
 - Agency comments suggested the use of VSP might give a more realistic number
 - VSP has several tools for statistical site characterization
 - Help identify and delineate potential target areas based on limited transect data
 - Couple of different methods to estimate count: Survey and Kriging
 - Workgroup identified that they had an excellent opportunity to compare a VSP estimate to final site data
 - OU-B1 Mount Moffett sites MM-10F, -10G and -10H

Introduction

- Why these sites?
 - Investigation data from 1999 through 2004
 - Transect and grid data
 - Dig Results
 - Remedial Action 2008 – 2010
 - 100% DGM data
 - 100% of targets were investigated
 - 100% dig results
 - Final anomaly counts and density maps were part of the project reporting



DGM Coverage 1999 - 2004



Anomaly Density – 2008 RA

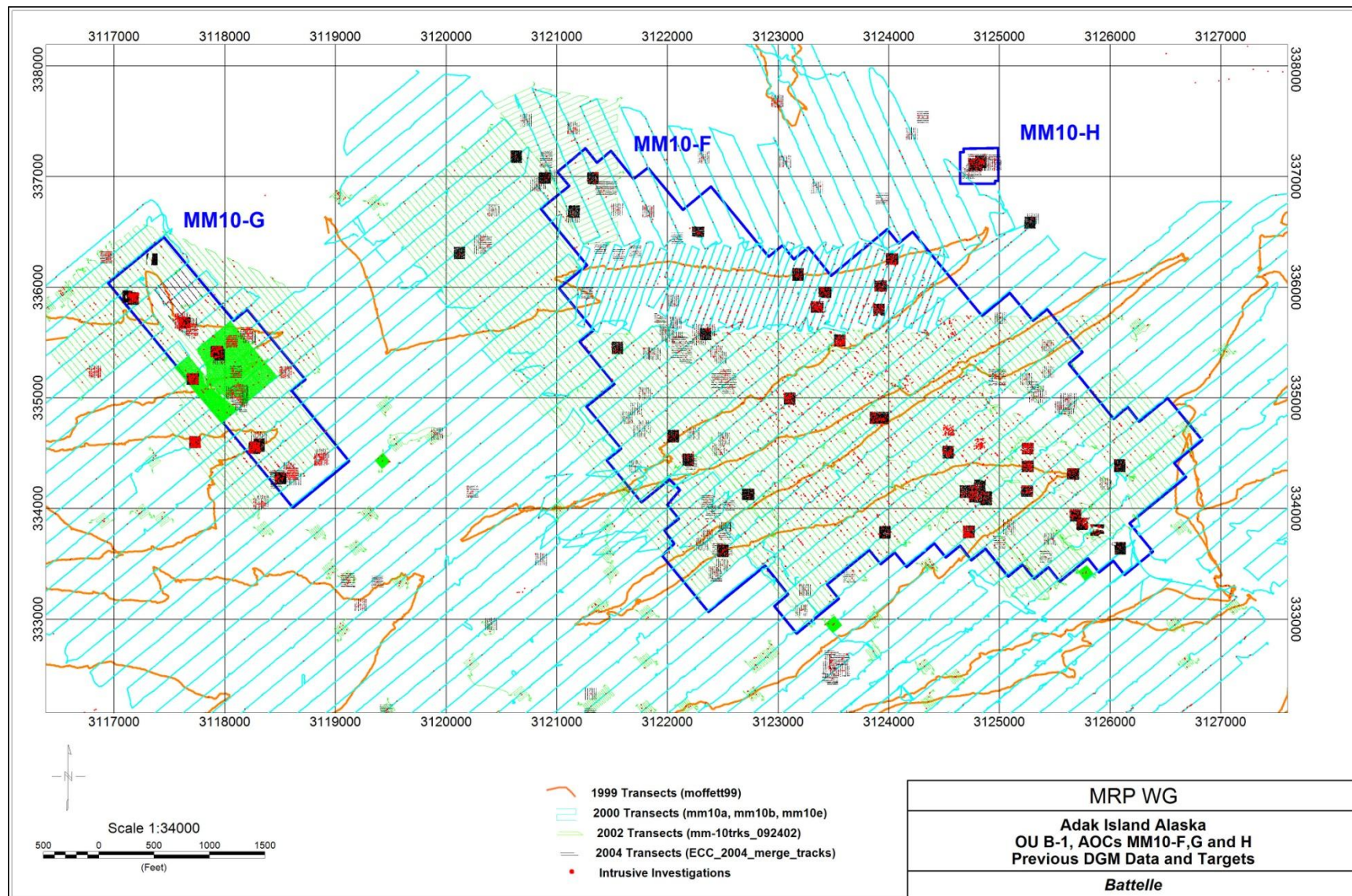
Purpose

- The purpose for the study was to compare the VSP estimates – anomaly count and density distribution – to the results from the remedial action.
- Purpose for this presentation:
 - Walk you through the process
 - Show you the results
 - Discuss what was learned from the exercise

OU-B1 Sequence of Events

OU-B1 Sequence of Events

| | Year(s) | Primary Event(s) | DGM System | Comments |
|----------------|-----------|--|--------------------------------------|--|
| VSP Input Data | 1999 | DGM Surveys and target removal | Mk1, 2mV-3mV, Ch1 | Semi-random, widely spaced transects (150m to 300m) |
| | 2000 | DGM Surveys and target removal | Mk1, 2mV-3mV, Ch1 | Parallel transects (50m mainly, some at 20m) |
| | 2002 | DGM Surveys and target removal | Mk1, 2mV-3mV, Ch1 | Parallel transects (20m), 30m x 30m mini-grids with either 1m or 5m lane spacing |
| | 2004 | DGM Surveys and target removal | Mk2, 3mV, Ch3 | 30m x 30m mini-grids with either 1m or 5m lane spacing |
| | 2004 | Surface sweep of MM-10F (TAVSC) | NA | At least 945 locations visited with multiple pieces of metal removed at each location |
| Ground Truth | 2008-2010 | Surface sweep of MM-10G, -10H; 100% DGM of all AOC | Mk2 Hybrid, 4mV – 4.4mV, sum Ch2,3,4 | ~3,500 lbs non-munitions debris and 61lbs MD removed during surface sweep; 100% DGM and investigation and removal of all targets above the threshold |



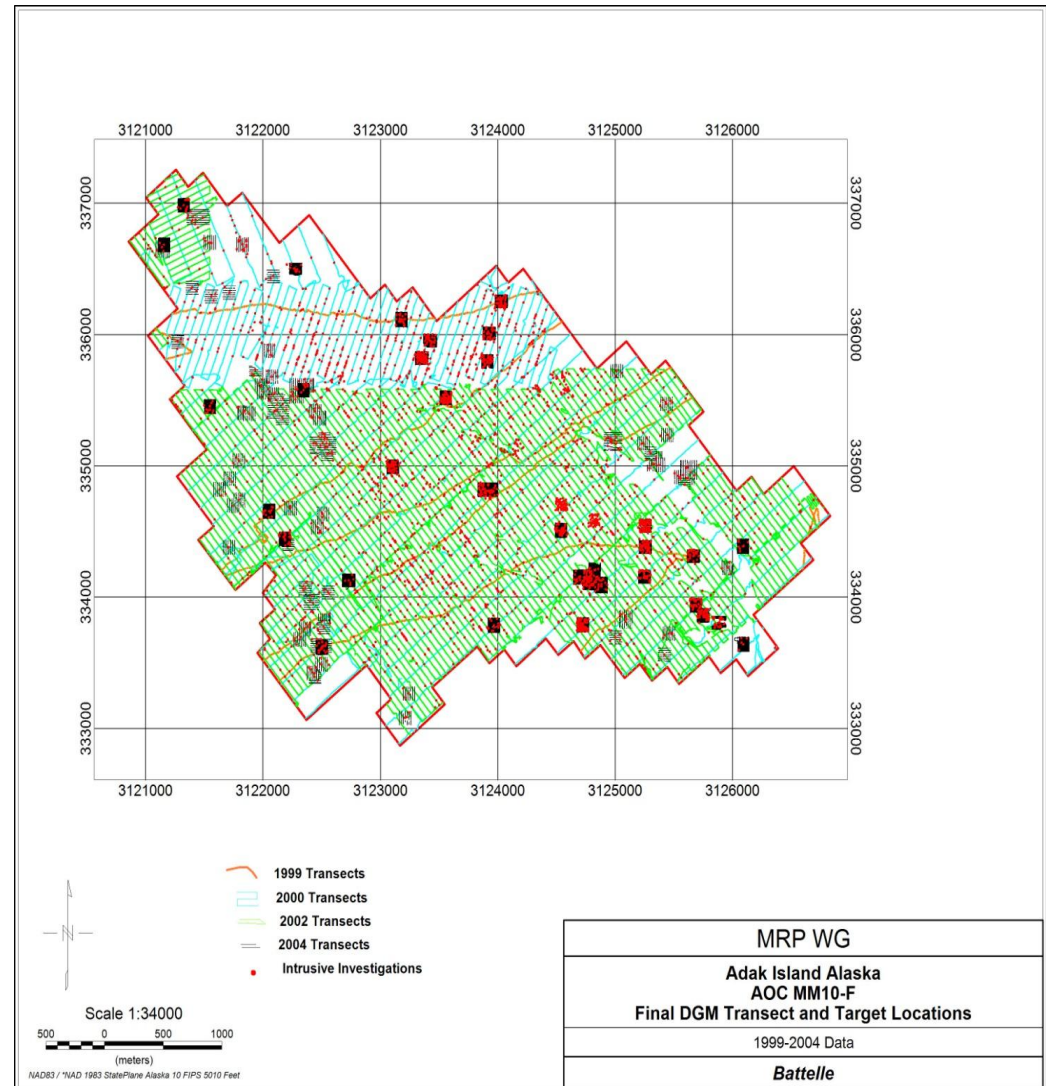
1999 to 2004 DGM Transect and Mini-grid Data

Process – Step 1

- Review Investigation DGM Data and Target Databases
 - DGM transects which were not processed were removed
 - Overlapping transects were removed
 - Only targets within the transect footprint were included – casual finds (visually acquired and removed, not in the DGM data) were removed from the databases
 - Excessive false positives (no finds) were de-sampled from the target databases (to achieve ~8% which was consistent with the historical rate at the site)

Process – Step 2

- Input the data into VSP
 - Map boundary of the study area
 - Coordinates of transect paths
 - Coordinates of targets

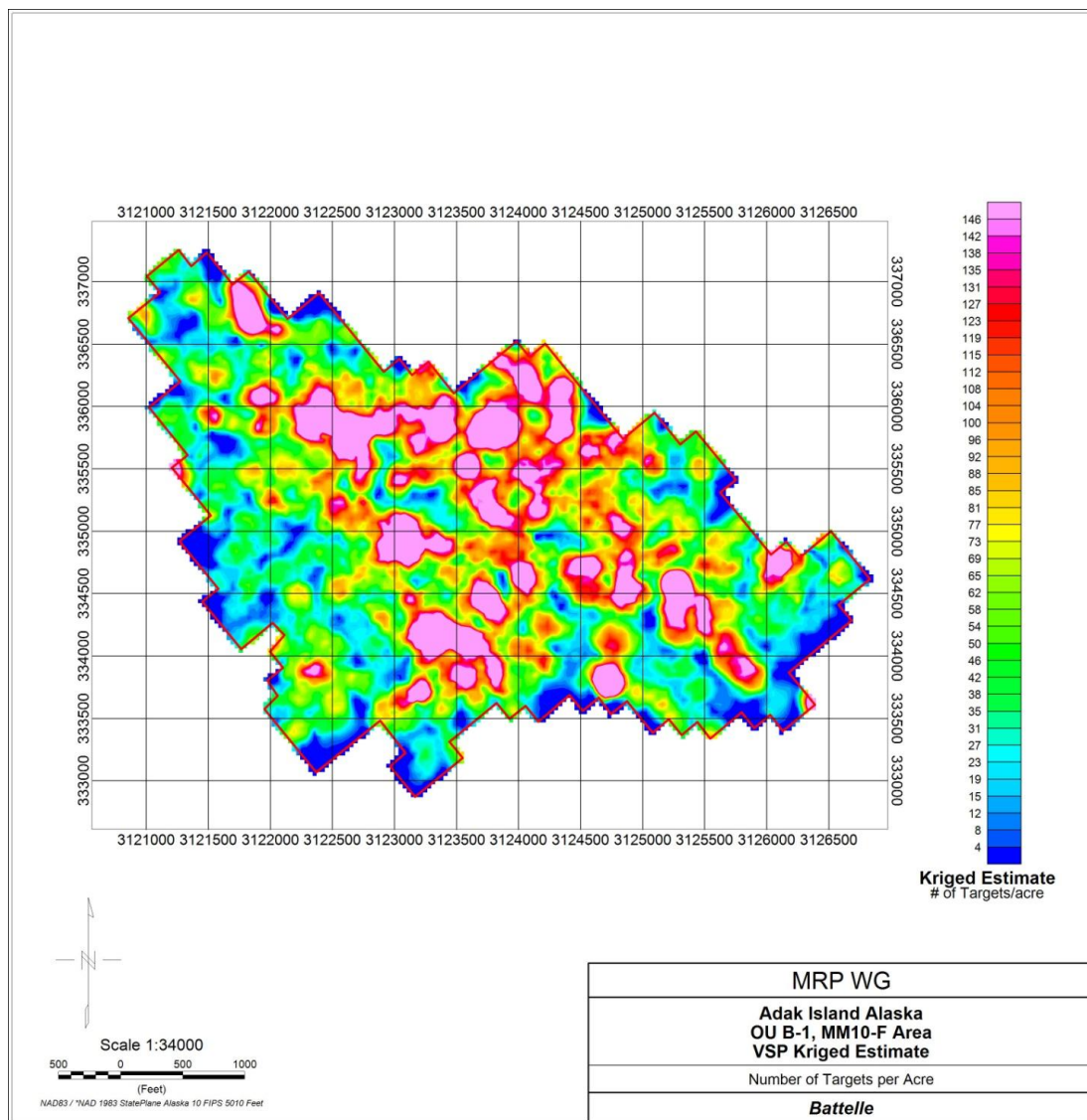


VSP Input Data for MM-10F

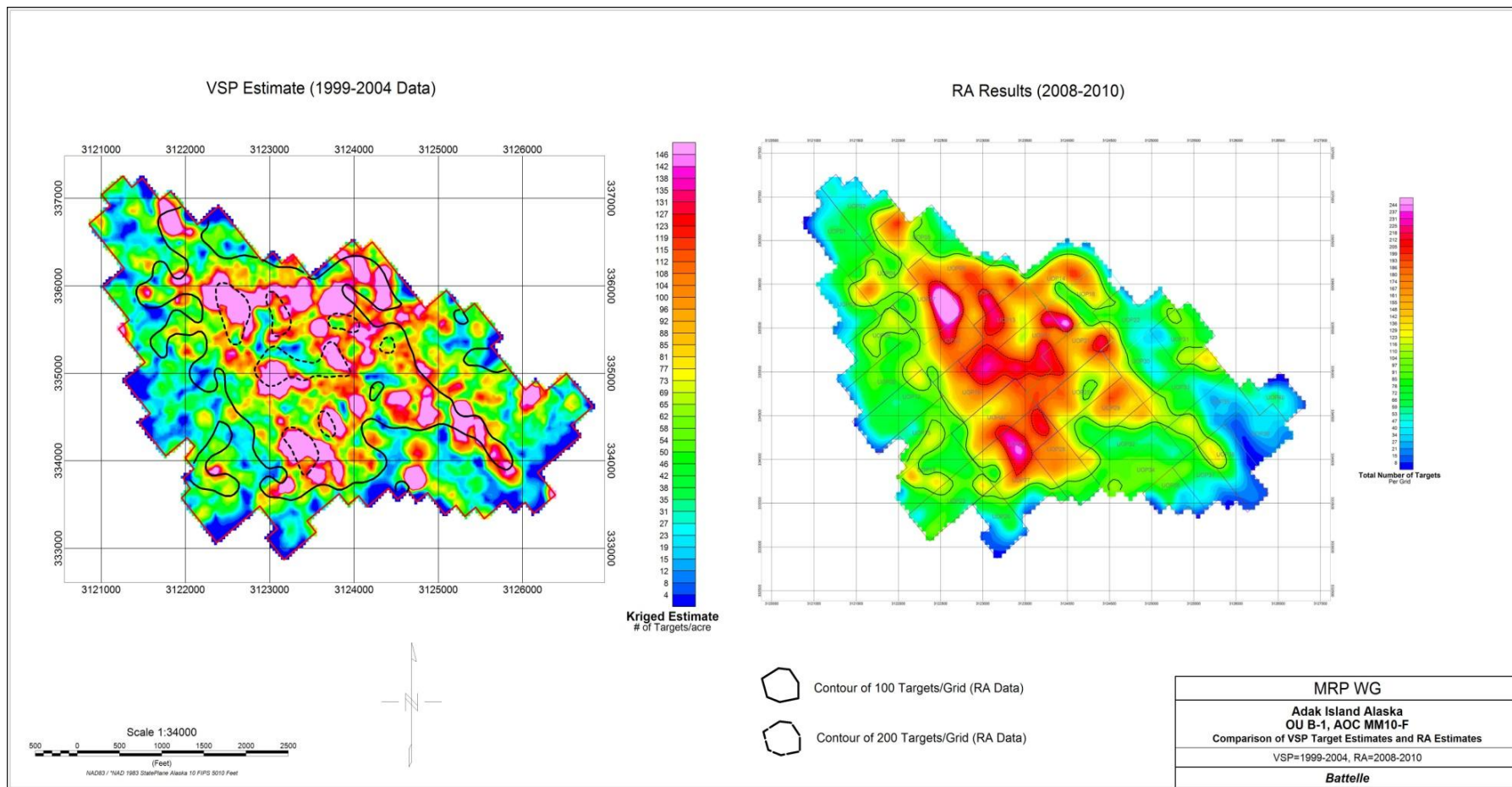
VSP Results

AOC MM-10F

| Subject | Value |
|------------------------------------|--------|
| Total area of AOC (acres) | 319.7 |
| Transect area (acres) | 43.84 |
| Detected targets in transects | 3,517 |
| Average Density (Survey) | 80.22 |
| Total potential anomalies (Survey) | 25,646 |
| Average Density (Kriged) | 71.085 |
| Total potential anomalies (Kriged) | 22,726 |



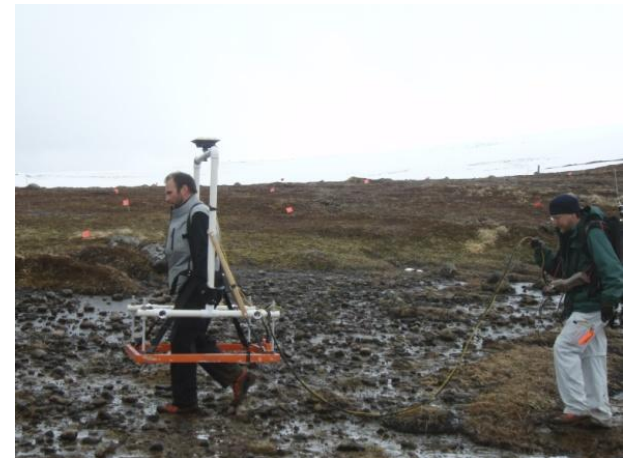
Comparison with RA Results



VSP Estimate (left) compared to RA results (right)

Analysis of MM-10F

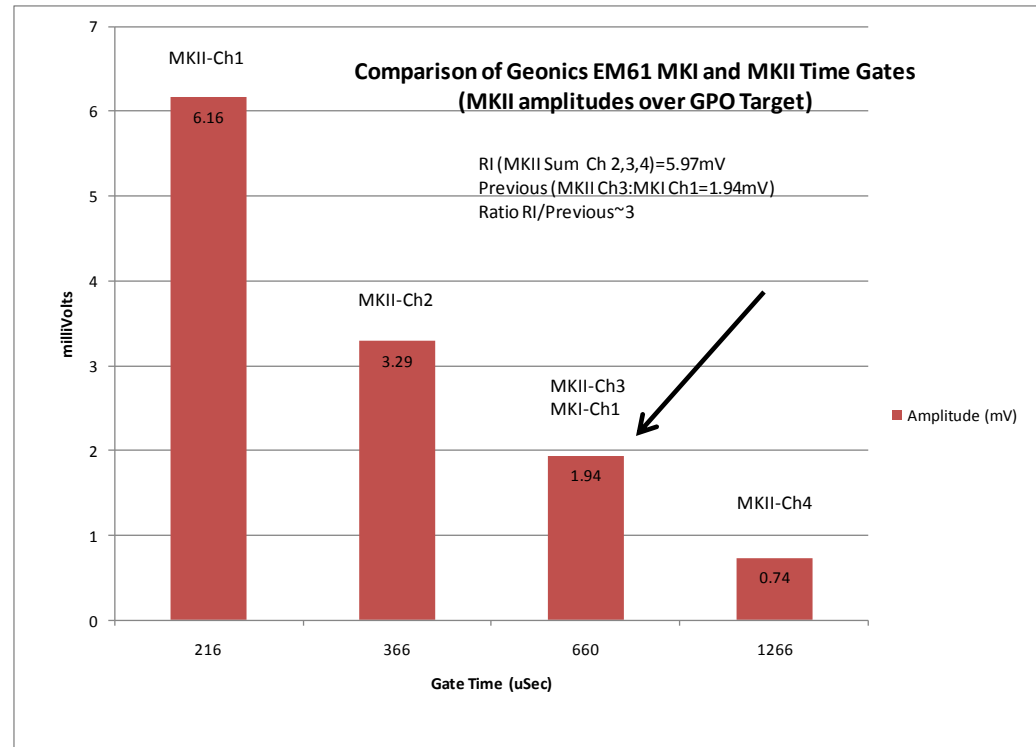
- Total # targets detected and remediated in -10F was 34,534
- VSP estimated survey (25,646) or kriged (22,726)
- Why might that be?
 - Differences in DGM equipment ?
 - Investigation used 1999 – 2002 EM61 Mk1 data
 - RA used 2008 EM61 Mk2 Hybrid data
 - Differences in target selection thresholds?
 - Some other reason?



EM61 Mk2 Hybrid (1m x 1m coil)

Analysis of Equipment/Threshold

- Figure shows that Mk 1 Channel 1 is equivalent to Mk 2 Channel 3
- Likely that 1999-2002 DGM used 2mV to 3mV for target selection
- In 2004 used a Mk2 at 3mV on Channel 3
- During RA (2008) targets were selected using sum Channels 2, 3 and 4
 - Threshold was between 2.9mV and 4.4mV
 - MM-10F was primarily picked at 4mV and 4.4mV
- Using sum of 2, 3 and 4 is on average 3 times the amplitude of Channel 3



Plot of MKII Channel Amplitudes Over Small Seed Item in the Geophysical Prove Out (GPO) in OU B-1 (Note: gate time is not to scale.)

Analysis of DGM – MM-10F

- If: Target threshold average of 2mV is assumed for the 1999-2004 DGM data;
- Then: adjusted RA threshold would be approximately 6mV
- Applying a 6mV threshold to the 2008 RA data yields:
 - 15,016 targets
 - A reduction of 19,518 (~57%)
 - The VSP estimate of 22,726 overestimates by 7,710 (51%)
- So how do you 'splain that?

Summary Info for all 3 sites

| AOC | Area (acres) | '99 to '04 Transect area (acres) | '99 to '04 Targets | VSP Average Density (Survey) | VSP Total Potential Targets (Survey) | VSP Average Density (Kriged) | VSP Total Potential Targets (Survey) | RA Total Targets (Known) | RA Total Targets at 6mV |
|-------|--------------|----------------------------------|--------------------|------------------------------|--------------------------------------|------------------------------|--------------------------------------|--------------------------|-------------------------|
| -10F | 319.7 | 43.84 | 3,517 | 80.22 | 25,646 | 71.09 | 22,726 | 34,534 | 15,016 |
| -10G | 42.75 | 7.19 | 755 | 105 | 4,492 | 74.78 | 3,197 | 3,436 | 1,865 |
| -10H | 2.5 | 0.82 | 120 | 145.84 | 364 | 96.79 | 242 | 829 | 139 |
| Total | 364.95 | 51.85 | 4,392 | | 30,502 | | 26,165 | 38,799* | 17,020 |

Navy estimate for bidding purposes was 27,150 targets

*Excludes blind seeds and survey corner pins

Possible Explanations

- Removal of Surface Metal after the Transect DGM
 - '99 to '04 DGM was conducted over the native terrain (e.g., no surface clearance)
 - In 2004, prior to the RA, a technology-aided surface clearance was performed in MM-10F.
 - The 2004 AAR shows that at least 945 locations were visited and often multiple metallic items were removed from each location
 - Conceivable, several thousand metallic objects (DGM targets) may have been removed from the AOC ahead of the RA DGM survey
 - In 2008, ahead of the RA DGM, surface clearance was conducted in MM-10G and -10H. ~3,500 lbs of metal debris were removed.
- Removal of Transect DGM Targets
 - All of the DGM targets identified in the transect surveys (4,392) were removed during the investigations
 - VSP does not subtract these targets from the estimate

Observations

- The VSP estimates (30,502 and 26,165) and the Navy estimate (27,150) are all within a reasonable range (<17%) of each other
- These estimates are well below the actual RA count (38,799)
 - RA had a much lower threshold 2.9mV – 4.4mV
 - RA used a more sensitive sensor (Mk2)
- At the 6mV threshold, the RA number decreases by > 50% and then the VSP estimate is high by >50%
 - Surface sweeps after the transect DGM but before the RA DGM may account for much of the difference
 - VSP does not remove the DGM targets that it uses from its estimate

Observations

- The 'surface sweep' discrepancy may be common on future projects
- The VSP estimate of target density showed good qualitative correlation with the actual RA data
 - These target density maps were used, in conjunction with other data, to develop the RAA boundaries for OU-B2 remedial action areas (this mornings' presentation here at E2S2)
 - Questions?

Mount Moffett

